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(54) CUSHIONING MATERIAL

(57)Abstract:

PURPOSE: To improve the cushioning and shape-following properties of a flexible three-dimensional network or foam body having interconnecting pores by coating the surface of the skeleton lattice of the body with a silicone bouncing putty.

CONSTITUTION: A silicone bouncing putty is obtd. by polymerizing 10-90 pts.wt. dimethylsiloxane having both terminals alkokylated and a viscosity at 25°C of 1-1,000cSt, 90-10 pts.wt. dimethylsiloxane having both terminals hydroxylated and a viscosity at 25°C of 1-15cSt. 0.1-15 pts.wt. boric acid, and 0-20 pts.wt. colloidal silica at 140-150°C for 2-10hr. A flexible three-dimensional network or foam body having interconnecting pores is immersed in a soln. of 100 pts.wt. silicone bouncing putty in 20-400 pts.wt. solvent and dried at room temp. to 100°C for 2min to 1 day to coat the surface of the skeleton lattice of the body with the putty, giving a cushioning material having a specific gravity of 0.1-0.8.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The charge of impact shock absorbing material characterized by covering the frame grid front face of the flexible three-dimensions reticulum which has internal free passage space, or a form object, and coming to coat with silicone van SHINGUPATE.
[Claim 2] The charge of impact shock absorbing material according to claim 1 the above-mentioned three-dimensions reticulum or whose form object is plastic foam of open cell nature.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] The configuration imitation family name of this invention is good, and is excellent in impact emollience, and it relates to the charge of impact shock absorbing material which is used suitable for personal protective equipment, such as a chair and a helmet, etc. for this reason.
[0002]
[Description of the Prior Art] Conventionally, plastic foam, the Ayr mat, gel, putty, etc. are used as charges of impact shock absorbing material, such as personal protective equipment, such as a chair and a helmet. However, plastic foam and the Ayr mat are light, and while excelling in deformans and the flattery nature to a form, if strong impulse force is applied, will deform easily, and have the problem it becomes impossible to fully demonstrate buffer nature. On the other hand, although gel and putty have sufficient impact buffer nature also to comparatively strong impulse force, a problem is in lightweight-ization.
[0003] Then, in the charge of impact shock absorbing material and JP,4-117974,A which mixed the minute hollow object in gel in JP,62-159601,A, the charge of impact shock absorbing material which mixed the elastic minute hollow object in van SHINGUPATE is proposed as what attained lightweight-ization of gel or putty.
[0004] However, when the impact buffer member concerning these proposals has the inadequate flattery nature to a form, or becoming expensive since it needs a special package when it is going to equip a helmet, or forming in a request configuration further, it has problems, like a configuration has a limit.
[0005] This invention was made in view of the above-mentioned situation, also when the impulse force beyond a predetermined value is applied, can ease stress by the minimum deformation, and aims at offering the charge of impact shock absorbing material which can moreover be formed in a desired configuration while it is lightweight and the flattery nature to a form is good.
[0006]
[Means for Solving the Problem and its Function] In order that this invention person may attain the above-mentioned purpose, as a result of inquiring wholeheartedly, sinking-in processing of the flexible three-dimensions reticulum or flexible form object which has internal free passage space, such as plastic foam of open cell structure, is carried out with the solution of silicone van SHINGUPATE. The charge of impact shock absorbing material obtained by covering the frame grid front face of the above-mentioned reticulum or a form object, and forming the coating layer of silicone van SHINGUPATE by the approach of making it dry etc. Where the above-mentioned internal free passage space is held, while the flattery nature to a form is good, a lightweight top The knowledge of the stress being certainly eased moreover enough, also when strong impulse force is applied, and excelling in impact buffer nature, and being able to form in a desired configuration easily is carried out, and it came to make this invention.
[0007] Therefore, this invention covers the frame grid front face of the flexible three-dimensions reticulum which has internal free passage space, or a form object, and offers the charge of impact shock absorbing material characterized by coming to coat with silicone van SHINGUPATE.
[0008] Hereafter, if this invention is explained further in full detail, the charge of impact shock absorbing material of this invention will use as a base the flexible reticulum or flexible form object which has internal free passage space.
[0009] Here, the porous matter which consists of fibrous material, such as quality of a porous natural product, such as plastic foam of the open cell structure of polyethylene, polystyrene, a polyvinyl chloride, polyurethane, phenol resin, a urea resin, methacrylic resin, and silicone resin, sponge, and a cork, textile fabrics, and a nonwoven fabric, as a reticulum or a form object is mentioned. In this,

polyurethane foam and silicone foam are desirable, a class is also abundant in existing especially flexible elastic polyether polyurethane foam and polyester polyurethane foam, and they can use it suitably also in the plastic foam of open cell structure.
[0010] Although especially the number of cels is not restricted when it is the diameter or plastic foam of the above-mentioned internal free passage space, in the case of polyurethane foam, it is desirable to set the specific gravity to 0.03-0.08 from the point of the impregnating ability at the time of sinking in the silicone van SHINGUPATE solution mentioned later. Moreover, since it is the same, in the case of silicone foam, it is desirable to set the specific gravity to 0.1-0.5.
[0011] Silicone van SHINGUPATE consists of a siloxane containing a boron atom, and can be obtained by the manufacture approach indicated by JP,26-6944,B. It can obtain, when the viscosity in 25 degrees C specifically carries out the polymerization of the 90 to dimethylsiloxane 10 section which has the both-ends hydroxy group of 1-10,000cst, the 0.1 to way acid 15 section, and the zero to colloidal silica 20 section to the ten to dimethylsiloxane 90 section (it is the same the weight section and the following) in which the viscosity in 25 degrees C has the both-ends alkoxy group of one to 1,000 centistokes (cst) in 140-150 degrees C for 2 to 10 hours for example, in a kneader.
[0012] In addition, if this silicone van SHINGUPATE is lengthened gradually, an impact is given to elongation and this with a hammer etc. like a starch sirup, it is divided like glass and it is left, it deforms gradually, becomes plate-like, and it has the property to bounce well rather than a rubber bowl.
[0013] In this case, as a solvent which dissolves silicone van SHINGUPATE, polar solvents, such as alcohols, ester, ketones, hydrocarbons, and halogenated hydrocarbon, can be used, and ketones, such as ester, such as acetic ester, a methyl ethyl ketone, and methyl isobutyl ketone, are especially recommended from the soluble point of silicone van SHINGUPATE.
[0014] As for the amount of these solvents used to silicone van SHINGUPATE, it is desirable to consider as the 20 to 400 section to the silicone van SHINGUPATE 100 section.
[0015] Such a solution is infiltrated into the above-mentioned reticulum or form objects, such as plastic foam. When forming the coating layer of silicone van SHINGUPATE in the frame grid front face of a reticulum or a form object It pulls up, after fully infiltrating the above-mentioned solution into the internal free passage space of the above-mentioned reticulum or a form object by immersing the above-mentioned solution in this reticulum or a form object. If the approach of squeezing out an excessive solution with a roll, a reticulum, or a form object is a split, the above-mentioned solution to both sides A roll coater, The approach of fully applying by a knife coating machine etc. (spreading sinking into the interior of a reticulum or a form object in the above-mentioned solution) can be adopted, and, subsequently the charge of impact shock absorbing material of this invention can be obtained by making it dry at room temperature -100 degree C for 2 minutes to one day.
[0016] In this case, although the amount of coatings of silicone van SHINGUPATE can be decided according to the application of the charge of impact shock absorbing material, it is desirable to consider as an amount from which the specific gravity of the charge of impact shock absorbing material after the above-mentioned desiccation serves as the range of 0.1-0.8 generally. Since the amount of formation of silicone van SHINGUPATE has too little this specific gravity less than 0.1, if sufficient impact buffer effect may not be obtained and this specific gravity exceeds 0.8, lightweight-ization of the goods equipped with the charge of impact shock absorbing material may not fully accomplish.
[0017] While the charge of impact shock absorbing material obtained as mentioned above deforms smoothly to quiet stress and following this When stress was removed, it recovers to the original form gently and the stress more than the specified quantity is applied, stress is eased by the minimum deformation. And it is lightweight and suitable for the application which forming in a desired configuration becomes an easy and cheap charge of impact shock absorbing material, and gives impact buffer nature, such as personal protective equipment, such as a chair and a helmet, for this reason.
[0018]

[Example] Although an example and the example of a comparison are shown and this invention is explained concretely hereafter, this invention is not restricted to the following example.
[0019] [examples 1-6 and the examples 1-6 of a comparison] -- the polymerization of the dimethylsiloxane 30 section which first has the both-ends hydroxy group of the viscosity as the above with the viscosity same in the dimethylsiloxane 70 section which has the both-ends ethoxy radical of 10 centistokes in 25 degrees C, the way acid 5.5 section, and the colloidal silica 3 section was carried out at 140-150 degrees C in the kneader for 4 hours, and silicone van SHINGUPATE was obtained. Subsequently, the ethyl-acetate 100 section was added to this silicone van SHINGUPATE 100 section, it dissolved by the mixer, and sinking-in liquid was prepared.
[0020] The above-mentioned sinking-in liquid was sunk into the urethane sponge (1cm in the polyurethane foam of made in Iso AKKU corporation and MF series, 5cm long, 5cm wide, thickness) shown in Table 1 by 5mm of roll **** with 2 rolls, it was left in the room temperature for 3 hours, and the charge of impact shock absorbing material was obtained by subsequently drying for 30 minutes at 80 degrees C.
[0021] In order to investigate the impact buffer nature of the charge of these impacts shock absorbing material, the drop test was performed with the following test method. Moreover, the impact buffer nature of urethane sponge which does not use silicone van SHINGUPATE was also measured for the comparison. Furthermore, measurement with the same said of silicone van SHINGUPATE as an example of reference was performed. A result is written together to Table 1.
[0022] It is made to fall on the sample (charge of impact shock absorbing material) which carried 22mm of diameters of method of impact buffer nature evaluation trial extraordinary, and a shot with a weight of 45g on the 5cmx5cmx5mm aluminum plate from height of 12cm and 48cm, respectively. The impulse force which a sample receives then is measured by the load cell (made in Kyowa, LU-200kg). Send out this measurement signal to DC amplifier (the product made from UNIPULSE, AM-30), and it amplifies about 1,000 times. This magnification value was sent out to the ANARAI zinc recorder (horizontal Kahoku a dragon the product made from electrical machinery, Model3655), waveform analysis was performed, the wave was recorded, and impact buffer nature was computed by the following type from the value (the maximum impulse force) of the recorded peak.
[0023] In addition, when the collision rate of a shot drops a shot from height of 12cm and the momentum of 3.06 m/sec and a shot drops [case / from 1.53 m/sec and height of 48cm] a shot from height of 12cm, the cases from 0.069 kgf-m/sec and height of 48cm are 0.138 kgf-m/sec.
[0024]
[Equation 1]

$$\text{衝撃緩衝性（%）} = \frac{\text{ブランクの応力} - \text{サンプルの応力}}{\text{ブランクの応力}} \times 100$$

[0025]
[Table 1]

		実施例1	比較例1	実施例2	比較例2	実施例3	比較例3	実施例4	比較例4	実施例5	比較例5	実施例6	比較例6	参考例
ポリウレタンフォーム		MF－20		MF－30		MF－40		MF－50		MF－55		MF－80		－
セル数（個／インチ）		20		30		40		50		55		80		－
比重*		0.08	0.03	0.27	0.03	0.26	0.03	0.34	0.03	0.34	0.05	0.40	0.08	1.12
衝撃緩衝性（％）	高さ12cm	97	89	97	97	97	98	97	94	97	97	96	97	91
	高さ48cm	62	20	90	44	91	32	93	31	93	45	94	59	91

* : although the example coated polyurethane foam with silicone van SHINGUPATE, as for the specific gravity of polyurethane foam, and the example of reference, specific gravity and the example of a comparison show the specific gravity of silicone van SHINGUPATE.

[0026] While the charge of impact shock absorbing material of an example has sufficient impact buffer nature also when large impulse force is given, and lightweight-ization is moreover attained from the result of Table 1, it turns out that the property of silicone van SHINGUPATE is fully demonstrated.

[0027]

[Effect of the Invention] While the charge of impact shock absorbing material of this invention deforms smoothly to quiet stress and following this When stress was removed, it recovers to the original form gently and the stress more than the specified quantity is applied, stress is eased by the minimum deformation. And it is lightweight and suitable for the application which forming in a desired configuration becomes an easy and cheap charge of impact shock absorbing material, and gives impact buffer nature, such as personal protective equipment, such as a chair and a helmet.

[Translation done.]

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(54) Title of Invention: Shock absorber material

(57) [Abstract]

[Constitution]

Shock absorber material consists of a flexible, three-dimensional mesh body or a foam body which has interconnected hollow spaces in its interior, and whose surface is coated with silicone bouncing putty.

[Effectiveness]

The invented shock absorber material is characterised by that it gradually changes its shape in response to slow stress with good shape-fitness; that it recovers its original shape when the stress is released; that it absorbs a shock by the minimum deformation when the impact is greater than a certain degree; that it is light, easy to be formed into any shape, and inexpensive. This material is suitably applied to a seat, a safety helmet and other protective gear.

[Scopes of Patent Application]

[Item 1]

Shock absorber material consists of a flexible, three-dimensional mesh body or a foam body which has interconnected hollow spaces in its interior, and whose surface is coated with silicone bouncing putty.

[Item 2]

Shock absorber material mentioned above whose body consists of a continuous-bubble plastic foam.

[Detailed Description of Invention]

[0001]

[Industrial application]

Because this material has excellent shape-fitness and shock-absorbing effects, it is suitably applied to a seat, a safety helmet and other protective gear.

[0002]

[Conventional technologies and their problems]

Plastic foam, air mat, gel, putty, etc. have conventionally been used as shock absorber material for a seat, a safety helmet and other protective gear. Plastic foam and air mat are light and have good flexibility and shape-fitness, but they deform too easily and have little shock-absorbing effect when a strong impact is made. Gel and putty have a good shock-absorbing effect against a strong impact, but it is difficult to reduce the weight.

[0003]

Attempts to reduce the weight of gel and putty include JP-S62-159601 and JP-H04-117974. The former is shock absorber material produced by mixing microscopic hollow material into gel. In the latter, elastic microscopic hollow material is mixed into bouncing putty.

[0004]

However, these shock absorber materials have some disadvantages: They have insufficient shape-fitness; When used for a safety helmet, they need to be wrapped in another special material, and it is expensive; They are not easily reshaped.

[0005]

The new shock absorber material proposed here is intended to achieve light weight; excellent shape-fitness; shock-absorption by the minimum deformation against the impact greater than a certain degree; and easy reshapability.

[0006]

[Approach and practice]

The new shock absorber material is made of a flexible three-dimensional mesh body or a foam body which has interconnected hollow spaces in its interior, for example, plastic foam with continuous bubble structure. A solution of bouncing putty is soaked onto it and dried. Thus, the material is coated with a layer of silicone bouncing putty. The product is light because it holds interconnected hollow spaces in its interior. It has excellent shape-fitness and shock absorbing effect against a strong impact, and it can easily be reshaped.

[0007]

This invention proposes new shock absorber material consisting of a flexible, three-dimensional mesh body or a foam body which has interconnected hollow spaces in its interior, and whose skeleton lattice surface is coated with silicone bouncing putty.

[0008]

Detailed description of the invention is as follows. The base body of this shock absorber material is a flexible three-dimensional mesh or a foam which has interconnected hollow spaces in its interior.

[0009]

Following materials can be used as the base body: polyethylene; polystyrene; polyvinyl chloride; polyurethane; phenolic resin; urea resin; methacrylic resin; plastic foam consisting of continuous bubble structure of silicone resin; such porous natural materials as sponge and cork; other porous materials consisting of such fibre substances as woven or unwoven cloths. Among all materials, plastic foam consisting of continuous bubble structure - polyurethane foam and silicone foam - are suitable. In particular, flexible and soft polyether polyurethane and polyester polyurethane have many different varieties of types and suitable for the base body.

[0010]

The diameter of the internal hollow space or the number of cells in plastic foam are not specified, but in general, the specific gravity of polyurethane foam should be from 0.03 to 0.08 in view of osmosis of the solution of silicone bouncing putty. For the same reason, the specific gravity of silicone foam should be from 0.1 to 0.5.

[0011]

Silicone bouncing putty consists of siloxane containing boron atoms. JP-S26-6944 gives information about how to produce it. To put it concretely, silicone bouncing putty is obtained by polymerizing, in a kneader at 140-150 degree C for 2-10 hours, the following materials. 10-90 pts.wt. dimethylsiloxane having both terminals alkokylated and viscosity at 25 degree C of 1-1,000cSt; 90-10 pts.wt. dimethylsiloxane having both terminals hydroxylated and a

viscostity at 25 deg.C of 1-10,000cSt; 0.1-15 pts.wt. boric acid; and 0-20 pts.wt. colloidal silica.

[0012]

Silicone bouncing putty has the following properties.

- It can be stretched like glutinous starch syrup.
- It is cracked when struck by such a solid material as a hammer.
- It gradually deforms itself into a flat shape when it is left untouched.
- Its elasticity is greater than a lubber ball.

[0013]

As the solvent of silicone bouncing putty such polar solvent as follows can be used: alcohol; ester; ketone; hydrocarbon; and halogenated hydrocarbon. Among all ester, e.g. acetic ester, and ketone, e.g. methyl ethyl ketone or methyl isobutyl ketone are particularly recommended.

[0014]

The ratio of the solvent to 100 pts.wt silicone bouncing putty is 20-400 pts.wt.

[0015]

To form a layer of silicone bouncing putty coated on the surface of skeleton lattice of a base body, it is immersed in the solution of silicone bouncing putty, letting the solution to soak into the base body. After taken out of the solution, unnecessary solution is squeezed out by using a roller. If the base body is thin, the solution is applied on both sides of the body by using a roll coater or a knife coater. To complete the coating, the material is dried at room temperature to 100 degree C for 2 minutes to 1 day.

[0016]

The quantity of coated silicone bouncing putty varies according to the use of shock absorber material, but in general, it is recommended that the specific gravity of the material after drying should be 0.1 to 0.8. If the figure is smaller than 0.1, the quantity of silicone bouncing putty is too small to achieve a good shock-absorbing effect. And if the figure is bigger than 0.8, the weight of the material will be too heavy.

[0017]

The shock absorber material thus obtained is characterised by that it gradually changes its shape in response to slow stress with good shape-fitness; that it recovers its original shape when the stress is released; that it absorbs a shock by the minimum deformation when the impact is greater than a certain degree; that it is light, easy to be formed into any shape, and inexpensive. This material is suitably applied to a seat, a safety helmet and other protective gear.

[0018]

[Practical examples]

Followings are practical examples of the production of the shock absorber material. Note that the method used here is not the only way of producing the material.

[0019]

[Samples 1-6 and comparisons 1-6]

First, silicone bouncing putty was obtained by polymerizing, in a kneader at 140-150 degree C for 4 hours, the following materials: 70 pts.wt. dimethylsiloxane having both terminals ethoxylated and viscosity at 25 degree C of l0cSt; 30 pts.wt. dimethylsiloxane having both terminals hydroxylated and a viscostity at 25 degree C of l0cSt; 5.5 pts.wt. boric acid; and 3 pts.wt. colloidal silica. Then, 100 pts.wt silicone bouncing putty and 100 pts.wt. acetic ethyl were dissolved by using a mixer to produce a solution.

[0020]

The solution of silicone bouncing putty was applied to urethane sponge (MF series polyurethane by Isoac Corporation; (L) 5cm x (W) 5cm x (H) 1cm) by using two rollers, which are placed at the distance of 5mm. After this, the urethane sponge is left untouched at the room temperature for 3 hours, and then it was dried at 80 degree C for 30 minutes. The shock absorber materials were thus obtained.

[0021]

To measure the shock absorbing effect of these materials, drop-ball tests were performed with the specifications described below. For the comparison, the shock absorbing effect of urethane sponge without silicone bouncing putty was measured. And, for reference, the shock absorbing effect of silicone bouncing putty without urethane sponge was also measured.

[0022]

[The method of measuring the shock absorbing effect]

A steel ball with an external diameter of 22mm and weight 45g is dropped from the height of 12cm and 48 cm on samples. The samples are placed on an aluminium plate whose size is (L) 5cm x (W) 5cm x (H) 5mm. The impact of the drop-ball is measured by a load cell (product of Kyouwa Co., LU-200kg). The signal is amplified by a direct current amplifier (product of UNIPULSE, AM-30) by 1,000 times. This amplified signal is sent to an analysing recorder (product of Yokokawa-Hokushin Denki, Model 3655), and the wave is recorded. The peak value of the recorded wave (the maximum impact) is used to calculate the shock absorbing effect in the following formula (Formula 1).

[0023]

The collision speed of the steel ball is 1.53m/sec at the height of 12cm and 3.06m/sec at 48cm. The momentum of the steel ball is 0.069kgf•m/sec at 12cm, and 0.138kgf•m/sec at 48cm.

[0024]

[Formula 1]

$$\text{Shock absorbing effect (\%)} = \frac{\text{blank stress - sample stress}}{\text{blank stress}} \times 100$$

[0025]

[Table 1]

		Sample 1	Comparison 1	Sample 2	Comparison 2	Sample 3	Comparison 3
Polyurethane foam		MF-20		MF-30		MF-40	
Number of cells / inch		20		30		40	
Specific Gravity *		0.08	0.03	0.27	0.03	0.26	0.03
Shock absorbing effect (%)	12cm height	97	89	97	97	97	98
	48cm height	62	20	90	44	91	32

Sample 4	Comparison 4	Sample 5	Comparison 5	Sample 6	Comparison 6	For reference
MF-50		MF-55		MF-80		-
50		55		80		-
0.34	0.03	0.34	0.05	0.40	0.08	1.12
97	94	97	97	96	97	91
93	31	93	45	94	59	91

* Specific gravity in the "sample" column shows that of polyurethane foam coated with silicone bouncing putty. "Comparison" column shows the specific gravity of polyurethane foam, and "for reference" column shows that of silicone bouncing putty.

[0026]

Table 1 shows that the new shock absorber material has sufficient shock absorbing effects against a strong impact, and the weight of material is light. This result exhibits the advantage of silicone bouncing putty.

[0027]

[Effectiveness of the invention]

The invented shock absorber material is characterised by that it gradually changes its shape in response to slow stress with good shape-fitness; that it recovers its original shape when the stress is released; that it absorbs a shock by the minimum deformation when the impact is greater than a certain degree; that it is light, easy to be formed into any shape, and inexpensive. This material is suitably applied to a seat, a safety helmet and other protective gear.